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Title: Network Paging System and Method

DECLARATION

I, Bobby D. Slaton, do declare and say:

1. I reside at 4912 Newbridge Drive, McKinney, Texas 75070 and have since April, 2005.
2. I am Corporate Counsel for Alcatel USA, authorized to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.
3. An Invention Disclosure Form (attached as Exhibit #A) was received in the Alcatel Intellectual Property Department on or about August 17, 2001.
5. The Invention Disclosure Form reflects a preparation date of **August 14, 2001**.
6. After consideration by an internal patent committee which convened quarterly, the Invention was approved for filing of a utility patent application on or about September 26, 2001.
7. Preparation of the utility application was completed for filing in January 2002.

I further declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further that all these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Date: September 5, 2006

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EXHIBIT “A”

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Local Docket No. _____

Alcatel Reference No. 8BD 0304 0341 URZZA

EX-371681

ALCATEL USA INVENTION DISCLOSURE FORM

Please e-mail a **soft copy** of this Form to Jerri Pearson at jerri.pearson@usa.alcatel.com and send a **signed paper copy** to Jerri (972 477-9128, Alcanet 2867-9128) at M/S LEGL2. This Form is available on the Alcatel USA Intranet Legal Department site.

Invention Title: Layer-2 application programming interface for IP paging

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Witness Signatures: I have read and understand this invention disclosure:

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2) _____ Date:

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**FIT (Fiche D'Information Technique)
TECHNICAL INFORMATION SHEET**
Alcatel USA Invention Disclosure Form

Title: Layer-2 application programming interface for IP paging

Author(s) of this FIT: Sridhar Gurivireddy, Behcet Sarikaya, Vinod Kumar Choyi and Xiaofeng Xu

Date: 08/14/2001

Originating Business Division/Unit: Network Strategy Group

Other Affected Business Divisions: MND and BND.

1. What is the technical problem that was to be solved?

Mobile IP defines a protocol that allows transparent routing of IP datagrams sent by a Correspondent Node (CN) (any Internet node that wants to communicate with a Mobile Node) to a Mobile Node (MN) in the Internet. IP paging protocol will be an extension to Mobile IP to allow dormant mode operation, i.e. save battery when not receiving/sending IP datagrams. Mobile node alternates between dormant and active modes to conserve its power. Mobile node does not perform location updates as long as it is in dormant mode. IP paging is a Layer-3 protocol used to find the paging area, in which the MN is located and to alert MN to come out of dormant mode, whenever there is an incoming traffic. Paging problem statement [3] defines the terminology and the problem of why IP paging is needed. Paging requirements document [1] defines architecture and a set of requirements that any IP paging protocol should conform.

IP paging protocol will benefit from a link layer (layer-2 or L2) operation if the link layer (Layer-2 or L2) could provide timely information to network layer (Layer-3 or L3) about the progress of events in layer-2. Layer-2 can pass information to layer-3 using triggers. Triggers and their associated application programming interface (API) defined in this patent can be used in the implementations of IETF's IP paging protocol, for gracefully bringing down layer-3 interface of the MN. In this document, triggers are defined as callback functions in C-language.

2. What were the best existing solutions (known to the inventor)?

To the authors' best knowledge, no existing documents/proposals defined paging triggers or its associated API. Triggers related to handoff were discussed in some earlier Internet drafts.

3. Why were these existing solutions not good enough?

There are no existing proposals, which define triggers and the associated C-language API for IP paging. Considering the L2 triggers for handoff that appeared in some recent Internet drafts, the motivations behind defining paging triggers and handoff triggers are different. Layer-3 handoff and context transfer protocols use handoff triggers to reduce latency in configuring a new interface for the mobile node at the new access point. Paging triggers can be used to gracefully bring down layer-3 configuration of MN and to detect the movement of MN in dormant mode to another subnet.

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4. What is the basic idea of the new solution described here? (Please make clear how this is different from the existing solutions)

The events in layer-2 are notified to upper layers through triggers. This document identifies triggers related to IP paging and defines them in the form of an application programming interface. Any new IP paging protocol to be standardized by IETF and the potential implementations of IP paging protocol will benefit from the API defined in this document. Basic uses of defining paging API can be listed as follows. The entities Mobile Node and Access Router are as indicated in the figure given below in Section 4.1.

Mobile Node can possibly use these triggers to

- Prepare for configuring layer-3 interface when mobile node comes out of dormant mode.
- Gracefully bring down L3 configuration of MN when it switches to dormant mode
- Detect that current L3 configuration at MN may possibly be invalid. i.e Detect the movement of MN to a different subnet in idle mode.

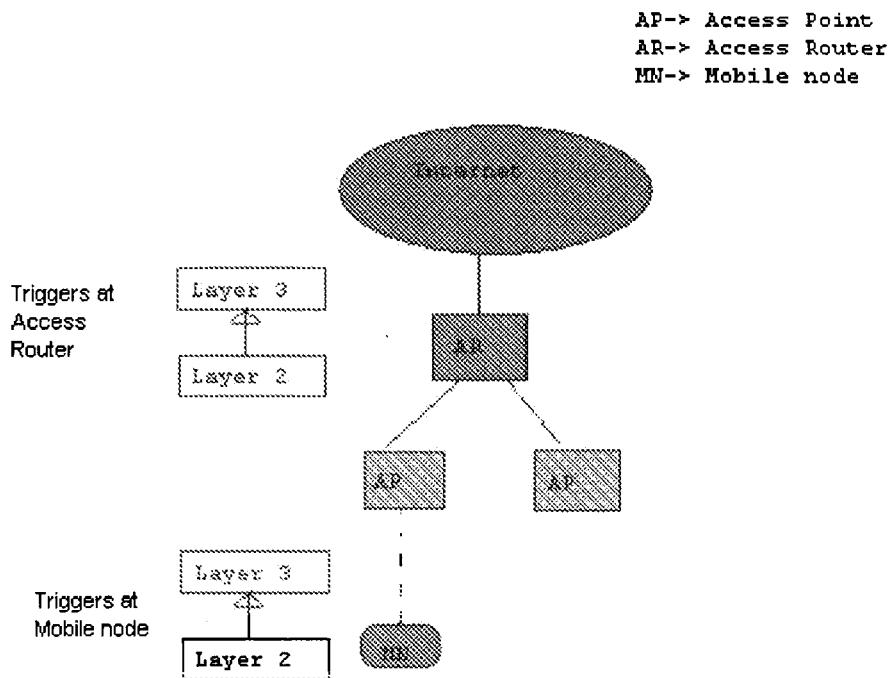
Access Routers can possibly use these triggers to

- Detect the change in status of connection of MN(dormant/active/Inactive)
- Determine if the MN is reachable {i.e. not in Inactive mode}
- Communicate among themselves to quickly reconfigure MN, when it comes out of dormant mode

This document doesn't discuss the ways of implementation of paging triggers. Typically, they may be implemented by callback functions (or) interrupts (or) an application layer protocol. Whenever the mobile node decides to enter sleep mode (dormant mode) (or) whenever the MN is a paged, layer-2 can pass the information to layer-3 using the triggers, defined in this document. Layer-3 can use this information to prepare for disconnection from existing layer-3 interface (or) to prepare for configuring a new layer-3 interface as soon as MN comes out of dormant mode.

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4.1. Pictorial representation of the solution:**5. Description of the solution****Glossary of terms used in defining triggers:**

- **Paging area:** Network may be divided into a set of areas called L2 paging areas. As long as MN moves within a single paging area, it need not perform location updates. The paging area refers to a layer-2 paging area as defined in the cellular systems of GPRS (or) UMTS standards.
- **Paging agent :** A node which distributes paging requests to MN upon the receipt of an incoming call
- **New paging area:** The layer-2 paging area into which MN has just moved
- **Paging request :** Layer-2 message used to notify MN that there is an incoming call
- **Access Router (AR):** The node with which MN has registered its layer-3 binding. Here AR is a generic term used to refer to "Access Router" in Mobile IPv6 and "Foreign Agent " in Mobile IPv4.

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Triggers that are identified to be useful for IP paging are:

L2 trigger	When	To	Parameters
MN paged	As soon as MN gets layer-2 paging request	w/into MN	Paged L2 address, Paging agent request L2 Address
New Paging area	As soon as layer-2 paging area changes	w/into MN	New Paging area L2 address
New Paging mode	As soon as MN changes its mode (active/ dormant /inactive)	w/into MN	New mode
Dormant MN reachable	As soon as network detects that a dormant MN is reachable {Previously network had information that dormant MN is unreachable}	w/into AR	-none-
Dormant MN not reachable	As soon as network loses track of a dormant MN.i.e. MN, which got disconnected from the network without making necessary updates	w/into AR	-none-
Start of L2 Paging request	As soon as L2 paging of MN starts	All Access Routers in whose area, paging is done	MN's L2 address w/into L2 page

These triggers can be defined in the form of an API. The remaining part of this section defines the C-language API.

5.1. Basic structures used in API:

Triggers are defined as callback functions. Applications register with these callback functions which in turn notify as soon as layer-2 trigger is fired. The trigger functions are blocking, in the sense the applications are blocked at the point they call these trigger API, until the trigger is fired.

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API assumes that characters are 8-bit wide and integers are 16-bit wide. All the strings (or) array of characters used in API are standard null terminated 'C' strings. Callbacks are used to define API. A library of callbacks can be defined, each representing one function of Layer-2 API. Concurrency in processing these triggers can easily be provided by using threads or processes. The data types of structure elements given in this patent are intended to be examples, not strict requirements.

5.1.1. Format of data types

Primitive data types, used in this document, follow the POSIX format. POSIX format is a standard format for defining APIs [2]. e.g. uintN_t means an unsigned integer of exactly 'N' bits.

5.1.2 IPv6/IPv4 Address [2]

This data structure contains an array of sixteen 8-bit elements, which make up one 128-bit Ipv6 address. IPv6 address is stored in network byte order.

For IPv6, layer-3 address is defined as

```
struct in6_addr{  
    uint8_t s6_addr[16];  
};
```

For IPv4, layer-3 address is defined as

```
struct in4_addr{  
    uint8_t s4_addr[4];  
};
```

Typecast "network_addr" to the addressing structure, used in the system as follows:

```
#ifdef PF_INET6  
typedef struct in6_addr struct network_addr;  
#endif  
  
#ifdef PF_INET4  
typedef struct in4_addr struct network_addr;  
#endif
```

5.1.3 Layer-2 address and paging area ID

This structure assumes that the size of layer-2 address is 64 bits [4]. If a specific L2 has a different size it should be defined accordingly.

```
struct l2_addr{  
    uint8_t link_addr[8];  
}  
  
typedef uint8_t layer2_paging_area_ID;
```

API assumes that paging area ID is of size 64 bits. If the size of paging area ID is different, it should be changed accordingly.

5.1.4. Return codes

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A list of error codes, which may be returned by callbacks, can be defined as follows

```
typedef enum
{
    L2_TRIGGER_RETURN =0
    L2_TRIGGER_ERR_NOT_DEFINED,
    L2_TRIGGER_ERR_SECURITY,
    L2_TRIGGER_ERR_NOT_SUPPORTED,
    L2_TRIGGER_ERR_CANNOT_REGISTER_HERE,
    L2_TRIGGER_ERR_TIMED_OUT,
    L2_TRIGGER_ERR_ALREADY_REGISTERED,
    L2_TRIGGER_ERR_NOT_REACHABLE
} L2APIReturnCode;
```

The following is a description of the reasons when the error codes are returned

Explanation of return codes

5.1.4.1 L2_TRIGGER_RETURN: This code is returned if the trigger is successfully caught.

5.1.4.2 L2_TRIGGER_ERR_NOT_DEFINED: This code is returned when a function tries to register an undefined callback.

5.1.4.3. L2_TRIGGER_ERR_SECURITY: This error is returned, if L2 prevents L3 from catching the trigger for security reasons

5.1.4.4. L2_ERR_NOT_SUPPORTED: This error code is returned when L3 tries to register a well-defined trigger, which is not supported by the underlying L2.

5.1.4.5. L2_TRIGGER_ERR_CANNOT_REGISTER_HERE: This error code is returned if the callback of trigger is not allowed at the place, this function was called.

5.1.4.6. L2_TRIGGER_TIMED_OUT: This error code is returned, if the trigger did not occur for certain amount of time after the callback was registered. L2 does not remember this callback any more.

5.1.4.7. L2_TRIGGER_ALREADY_REGISTERED: This error code is returned if an application has already registered this callback and if the same callback cannot be registered by two or more applications.

5.1.4.8. L2_TRIGGER_ERR_NOT_REACHABLE: This error code is returned if an application tries to catch a trigger for MN, which has a state "unreachable" in layer-2. This can be because MN has not performed location/periodic updates.

5.2.Paging API:

5.2.1. MN paged

This trigger must be sent to MN as soon as it gets a paging request. The access point from which it received the address and the ID of the paging area are the parameters of the trigger.

```
void catch_trigger_MN_paged(L2_address*, paging_area_ID*, L2APIReturnCode* code);
```

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5.2.2. New paging area

This trigger must be sent to layer-3 at MN as soon as MN finds that it has changed layer-2 paging area. New paging area ID is sent as parameter.

```
Paging_Area_ID new.paging_area(L2APIReturnCode* code);
```

5.2.3. New paging mode

Layer-3 at MN must be informed by layer-2 whenever it changes its mode.
(Dormant/Active/Inactive)

```
int new.paging_mode_trigger(L2APIReturnCode* code);
```

The return values of the function are

0 for dormant mode
1 for Active mode
2 for inactive mode

5.2.4. Start of paging request

This trigger should be sent to layer-3 in all subnets within the paging area. All the access routers need not be informed at the same time.

```
L2_address paging_request_start(L2APIReturnCode* code);
```

5.2.5. Dormant MN reachable

As soon as MN reconnects to the network, this trigger should be sent to layer-3 at the Access Router, where MN has registered its layer-3 interface. This trigger should be sent to layer-3 only when MN's state in layer-2 changes from "unreachable" to "reachable".

```
void dormant_MN_reachable(L2APIReturnCode* code);
```

5.2.6. Dormant MN not reachable

This trigger should be sent at layer-3 of access router, as soon as network detects that MN is not reachable. This trigger should be sent to layer-3 only when MN's state in layer-2 changes from "reachable" to "unreachable".

```
void dormant_MN_not_reachable(L2APIReturnCode* code);
```

6 References:

[1] [RFC 3154](#), Requirements and Functional Architecture for an IP Host Alerting Protocol

[2] [RFC 2553](#), Basic Socket Interface Extensions for IPv6

[3] [RFC 3132](#), Dormant Mode Host Alerting ("IP Paging") Problem Statement

Informational

Internet Draft

Document: [draft-manyfolks-l2-mobilereq-00.txt](http://www.ietf.org/internet-drafts/draft-manyfolks-l2-mobilereq-00.txt)

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Requirements for Layer 2 Protocols to Support Optimized Handover for IP Mobility

Status of this Memo

This document is an Internet-Draft and is in full conformance with all provisions of Section 10 of RFC2026. This is an individual draft for consideration by the Mobile IP Working Group.

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Abstract

A critical factor in achieving good performance for IP mobility protocols is the design of L2 handover. Handover occurs when a Mobile Node moves from one radio Access Point to another. If the new radio Access Point is associated with a new subnet, a change in routing reachability may occur and require L3 protocol action on the part of the Mobile Node or Access Routers. If no change in subnet occurs, the Access Point may still need to take some action to inform the Access Router about a change in on-link reachability. In

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either case, prompt and timely information from L2 to the parties involved about the sequencing of handover can help optimize handover at the IP level. This draft discusses requirements for an L2 handover protocol or API to support optimized handover.

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1.0 Introduction

An important consideration in the design of IP mobility protocols is handover. A moving Mobile Node (MN) may irregularly need to change the terrestrial radio Access Point (AP) with which it is communicating. The change in L2 connectivity to a new AP may cause a change in IP routing reachability, and thus require either the MN or the Access Routers (ARs) to perform actions that update routing information for the MN. Even if no change in subnet occurs, the APs may still need to communicate the change in on-link reachability to the local AR. In order for handover to occur, candidate APs must be identified and a target AP must be selected [10]. Once this process has been complete, the handover process can begin.

Several protocol designs have been advanced for Mobile IP that seek to reduce the amount of handover latency at L3 [3] [4] [5]. These protocols depend on obtaining timely information from the L2 protocol about the progress of handover. An additional beneficiary of timely handover progress information is context transfer [6]. Context transfer involves moving context information (QoS, header compression, authentication, etc.) from the old AR to the new. By moving such context information, the ARs can avoid requiring the MN to set up all the context information from scratch, considerably reducing the amount of time necessary to set up basic network service on the new subnet. If handover progress information is available from L2, context transfer can proceed more quickly.

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This document discusses requirements for an L2 handover protocol or API to support optimized L3 handover. While the document has been written with existing Mobile IP work in mind, it should be applicable to any protocol that can benefit from knowledge about L2 events to facilitate mobility. Requirements for assisting in handover between two APs on the same subnet, between two ARs on different subnets, and for context transfer between ARs are discussed.

2.0 Terminology

The following terms are used in this document.

Access Point (AP)

A Layer 2 (L2) access entity, e.g. a radio transceiver station, that is connected to one or more Access Routers. Its

primary function is to provide MNs an L2 wireless link via its specific air-interface technology.

Access Router (AR)

A Layer 3 (L3) IP router, residing in an access network and connected to one or more Access Points. An AR is the first hop router for a MN.

L2 Handover

Change of MN's link layer connection from one AP to another. No change in off-subnet routing reachability information is required.

L3 Handover

Change of MN's routable address from one AR to another. An L3 handover results in a change in the MN's routing reachability, that will require action on the part of the IP mobility protocol running in the MN and/or ARs.

3.0 L2 Trigger Definition

This section discusses defining L2 triggers that provide information on the sequencing of handover. An L2 trigger is not associated with any specific L2 but rather is abstracted from the kind of L2 information that is or could be available from a wide variety of radio link protocols.

3.1. What is an L2 Trigger?

An L2 trigger is an abstraction of a notification from L2 (potentially including parameter information) that a certain event

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has happened or is about to happen. The trigger may be implemented in a variety of ways. Some examples are:

- The L2 driver may allow the IP stack to register a callback that is called when the trigger fires. The parameters associated with the trigger are delivered to the callback.
- The operating system may allow an application layer thread to call into a system call for the appropriate trigger or triggers. The system call returns when a particular trigger has fired, with parameter information as a return value of the system call.
- The trigger may consist of a protocol for transferring the trigger notification and parameter information at either L2 or L3 between the new AP or AR and the old AP or AR. The parameter information is included as part of the protocol. This allows the IP stack on a separate machine to react to the trigger. The IAPP protocol [7] is an example of such a protocol.

In any case, the implementation details of how the information involved in an L2 trigger are transferred to the IP mobility protocol are likely to color how the mobility protocol is implemented on top of that L2, but they should not influence the specification of the abstract L2 triggers themselves.

3.2. Information in an L2 Trigger

There are three types of information involved in defining an L2 trigger:

1. The event that causes the L2 trigger to fire,
2. The IP entity that receives the trigger,
3. The parameters delivered with the trigger.

The IP entities that can receive the trigger depend on the particular IP mobility protocol in use. Here are some possible IP entities, based on work done with L2 triggers and Mobile IP:

- | | |
|----|--|
| MN | The MN may receive an L2 trigger allowing it to start or conclude a mobile controlled handover. |
| FA | In Mobile IPv4, the Foreign Agent (FA) is located on the last hop before the wireless link. The last hop can be either an AP or AR or even a separate host. An FA can make use of triggers to start or conclude network controlled handover. |
| AR | The AR can obtain an L2 trigger directly from the wireless link if one of its interfaces is on the |

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link (that is, the AR is also an AP), or it can obtain an L2 trigger indirectly by L2 or L3 protocol messages from the AP.

4.0 L2 Handover Requirements for L2 Triggers

On the face of it, specifying requirements for pure L2 handover (i.e. no change in IP routing reachability) might seem out of scope for IETF. Existing wireless networks typically have special L2 AP-AR interfaces with L2 address update built in. For these systems, L2 triggers are unnecessary.

However, current trends in wireless networking suggest that future wireless networks will consist of a variety of heterogeneous wireless APs bridged into the wired network, potentially on the same subnet. A change in wireless AP, either between an AP supporting one wireless link technology and an AP supporting another, or between two APs supporting the same wireless technology, necessarily results in a change in the on-subnet reachability. Packet delivery within the subnet can be optimized if this information can be propagated to the AR, so it can update its on-subnet L2 address to IP address mapping.

In addition, the old AP may benefit from a notification that the MN has moved in the event it is not involved in the handover (as is the case with some WLAN radio protocols), by allowing the old AP to more quickly de-allocate resources dedicated to the moved MN. Some radio link protocols already define IP-based L2 trigger protocols for this purpose [7]. When APs supporting multiple radio technologies on a single subnet are involved, however, interoperability suffers if there is no L2-independent way of reporting on-link movement. Table 1 contains a list of L2 handover requirements for L2 triggers.

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L2 Trigger	Event	Recipient	Parameters
Intra-L2 Handover Start	Before handover between two APs supporting the same radio link technology.	Current AR MN	MN's new downlink L2 address New AP's uplink L2 address
Inter-L2 Handover Start	Before handover between two APs supporting different radio link technologies.	Current AR MN (optional, only supplied if MN does not obtain otherwise)	MN's new downlink L2 address (radio link technology specific) MN's old downlink L2 address (radio link technology specific) New AP's uplink L2 address (radio technology specific)
Inter-L2 Old Link Down	When the old L2 link is disappearing and before disabling the old L2 link.	Current AR MN	MN's new downlink L2 address (radio link technology specific) MN's old downlink L2 address (radio link technology specific) New AP's uplink L2 address (radio technology specific)

specific)

Table 1 - L2 Handover Requirements

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L2 Mobility Handover Optimization Requirements July 2001

5.0 L3 Handover Requirements for L2 Triggers

The requirements discussed in this section have proven highly useful as a device in structuring low latency handover protocol designs for Mobile IPv4 and Mobile IPv6 [3] [4] [5]. An L2 that supports these requirements is a good candidate for a performance Mobile IP implementation. Table 2 contains the requirements for the L2 triggers. The description for a trigger contains the trigger name, the L2 handover event causing the trigger to fire, what entities receive the trigger, and parameters, if any. The recipient is qualified by the IP mobility protocol in which the recipient plays a role. If the recipient does not have AP functionality (i.e. the recipient does not have an interface directly on the wireless link), the trigger information must be conveyed from the AP where it occurs to the recipient by an L2 or L3 protocol.

L2 Trigger	Event	Recipient	Parameters
Link Up	When the L2 link comes up.	AP/AR MN	MN L2 address to AP/AP AP/AR address to MN
Link Down	When the L2 link goes down.	AP/AR MN	MN L2 address to AP/AR AP/AR address to MN Boolean cause (inadvertent/deliberate)
Source Trigger	Sufficiently before L2 handover start for pre-handover L3 message exchange across the wired and/or wireless link	MIPv6: oAR MIPv4: oFA	nAR or nFA IP address or L2 address that can be mapped to an IP address MN L2 address
Target Trigger	Sufficiently before L2 handover finish for pre-handover L3 message exchange across the wired and/or wireless link.	MIPv6: nAR MIPv4: nFA	oAR or oFA IP address or L2 address that can be mapped to an IP address MN L2 address
L2 Handover Start	When L2 handover begins	MIPv6: oAR or nAR MIPv4: oFA or nFA MN	MN L2 address to oAR/nAR MN L2 address to oFA/nFA MIPv6: oAR/nAR address or MIPv4 oFA/nFA address to MN

Table 2 - L3 Handover Requirements

6.0 Context Transfer Requirements for L2 Triggers

Context transfer (CT) is a relatively new issue for supporting seamless mobility between two nodes that provide access to a mobile node. Although lacking a "de facto" CT protocol specification at this time, plausible approaches toward CT framework are well

described in [8] [9]. Conceptually, the CT framework suggests two distinctive modes of operation, namely, reactive and proactive. In this section, specific modifications to L2 triggers that suffice both the reactive and the proactive context transfers are discussed.

6.1. Types of Context Transfer

Reactive CT takes place subsequent to a MN establishing a new link with the new AR. Thus, the context information required should be transferred to the new access router after the MN completes the new link with the new access router. Although this timing requirement is loosely defined, it is desirable to initiate reactive CT sometime before (or about the same time as) the L2 handoff initiation. It is also noteworthy that the old access router is not always restricted to being the context source, i.e. where the context is transferred *from*.

Proactive CT requires that the context is present at the new AR prior to the arrival of MN's packets at the new AR. The timing requirement for proactive CT is stricter because it may be possible that some of the context is still in transit when packets begin to arrive for the MN at the new access router.

6.2. Requirements for L2 Triggers for Context Transfer

Similarly as FMIP L2 triggers (as defined in Section 4.0), L2 triggers for context transfer operating on either reactive or proactive mode are defined in Table 3.

L2 Trigger	Event	Recipient	Parameters
Proactive CT L2 Target Trigger	Sufficiently before L2 handover initiation that CT can be completed before route/tunnel for packets to MN on new AR is set up.	nAR	oAR or Context Transfer Source (CTS) L2/L3 address identifiers.
Proactive CT L2 Source Trigger	Sufficiently before L2 handover initiation that CT	oAR	nAR or Context Transfer Target (CTT) L2/L3

	can be completed before route/tunnel for packets to MN on new AR is set up.		address identifiers.
Proactive CT L2 Mobile Trigger	Sufficiently before L2 handover initiation that CT can be completed before route/tunnel for packets to MN on new AR is set up.	MN	nAR or Context Transfer Target (CTT) L2/L3 address identifiers.
Reactive CT L2 Target Trigger	Upon completion of the L2 handover.	nAR	oAR or Context Transfer Source (CTS) L2/L3 address identifiers
Reactive CT L2 Source Trigger	Upon initiation of L2 handover.	oAR	nAR or Context Transfer Source (CTS) L2/L3 address identifiers.
Reactive CT L2 Mobile Trigger	Upon the initiation of L2 handover.	MN	nAR or Context Transfer Target (CTT) L2/L3 address identifiers

Table 3 - Context Transfer Requirements

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7.0 Benefits of L2 Triggers for Other Systems

While the primary purpose of L2 triggers described in this draft is to aid L2 mobility optimization, L2 triggers can also benefit networks without Mobile IP or other IP mobility protocol support. For example, IP addresses may change due to stateless or stateful address configuration whenever hosts are unplugged from the network or replugged into a different subnet.

Use of L2 triggers in such situations enables efficient state management in the AR. The AR can clean up the associated state as soon as it detects that a host has been disconnected through the L2 Link Down trigger, for example. State clean up includes removal of ARP or Neighbor Cache entries, and can save bandwidth by inhibiting incoming data on the link where the host was once connected.

Additionally, faster and more efficient router discovery is possible if the AR receives a L2 Link Up trigger for a host. When the AR receives the trigger, it can send an unsolicited unicast router advertisement to the host. The host can begin the process of establishing IP connectivity more quickly.

8.0 Security Considerations

The L2 triggers convey information about the link state of the MN

and this information can trigger IP layer changes in routing reachability. As such, the information in an L2 trigger, if misused by an adversary or fraudulently propagated, could result in denial of IP service to the MN or hijacking of the MN's packets to a hostile third party.

If the L2 trigger is implemented as an API on an AR or AP, then the operating system and API implementation are required to assure that only qualified users can call into the API. Normally this involves denying access through the API unless the process running the API client has the proper security credentials on the host. If the L2 trigger is implemented as an L2 or L3 protocol, the protocol is required to protect the trigger messages with the proper authentication. In particular, if the protocol is an IP-based protocol, it must include authenticators so the parties that use the protocol can authenticate each other. If the protocol is intended to be used on public data networks, the option of encrypting the traffic must be available, to grant some privacy over the MN movement information propagated by the protocol messages.

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